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BLIGHT OF KENAF [1]

SEBASTIAN S. QUINIONES AND F. T. ORILLO

WITH FIVE TEXT FIGURES

Blight of kenaf is a disease of the leaves, shoots, and blossoms. It causes premature defoliation, death of shoots, markedly retarded growth, and rotting of blossoms. The lesions on the leaves are water-soaked at first, olive-gray when old, either circular or irregular, and dotted with black specks composed of the fruit bodies of the fungus. Infected shoots are shrunken, grayish black, and usually dotted with numerous pycnidia.

The disease is caused by *Phoma sabdariffae* Sacc., which grows luxuriantly and produces abundant pycnidia on potato-dextrose agar, malt agar, onion agar, oatmeal agar, and kenaf-decoction agar. All varieties of kenaf used in pathogenicity tests and observed in the field were equally susceptible to the disease. Cross-inoculation experiments showed that both the red and white varieties of roselle are readily infected by the pathogen. The pycnospores of the fungus may remain viable for six to eight months in diseased host tissues. They may be disseminated by rain, wind, insects, and by seeds of diseased plants. The disease may be controlled by sanitation, crop rotation, selection and disinfection of seeds, and, perhaps, by protection of plants with fungicides such as "530 Spraycop" and "Fermate."

This study on the blight of kenaf (*Hibiscus cannabinus* Linn.) was conducted from December, 1951, to February, 1953, in the Department of Plant Pathology and in the kenaf fields of the College of Agriculture and nearby localities for the purpose of (1) securing accurate information about the disease as it occurs in the field and as it is reproduced in the laboratory, (2) determining the morphological and physiological characteristics of the causal fungus, and (3) formulating control measures based on the results of the study of the disease and its cause.

THE DISEASE

Blight of kenaf has not been reported hitherto in countries where this fiber plant is grown. In the Philippines, the disease was first observed by Manzano [2] in the latter part of August, 1951, when it caused a destructive blight on the leaves, shoots, and blossoms of kenaf planted in the Central Experiment Station, College of Agriculture. In 1952, the writers found the same disease affecting about 50 per cent of the kenaf crop in the experimental plots of the Department of Agronomy.

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[1] Central Experiment Station Contribution No. 1678. Based on the thesis presented by the senior author for graduation with the degree of Bachelor of Science in Agriculture. Prepared in the Department of Plant Pathology under the direction of the junior author.

[2] MANZANO, TOBIAS B. 1952. Influence of the rate of seeding on yield of fiber and seed and on quality of fiber of kenaf. Philippine Agriculturist **35**: 561-571. *Fig. 1.*

[THE PHILIPPINE AGRICULTURIST, Vol. 36, No. 4, September, 1952, appeared in September, 1953]
THE PHILIPPINE AGRICULTURIST, Vol. 36, No. 5, October, 1952.

Symptoms

On the leaves. Infection may start on any portion of the leaf blade, the young leaves being more susceptible than the old ones. At the start, the lesions are small, water-soaked, and either circular

Fig. 1.—Upper panel—kenaf leaves of varying ages, showing early and advanced symptoms of the disease caused by *Phoma sabdariffae* (×½); lower panel—shoots of kenaf infected with *Phoma sabdariffae* (×⅔). *Photographed by Dr. J. Banzon, Photographic Division, College of Agriculture.*

or irregular, with distinct pale green borders. They enlarge rapidly during cool and moist days, attaining a diameter of 3 to 5 centimeters (fig. 1, upper panel). As infection advances the entire leaf becomes

blighted. Under laboratory conditions, inoculated leaves usually fall off before the appearance of the fruit bodies of the fungus. Under field conditions, pycnidia are profusely produced on the lesions even before the leaves fall to the ground. Other infected leaves may persist on the plant until they are killed.

On the shoots. The fungus generally starts at the apex or, in some cases, at the more mature portion a few centimeters below the apex and develops downward to the third or fourth node. Infected shoots are shrunken, grayish black, and dotted with minute bodies, which are the pycnidia of the fungus (fig. 1, lower panel). Eventually the shoots droop and hang at the juncture of the diseased and healthy portions of the stem. Thus, at a distance, plants with infected shoots appear as if they had been topped.

On the blossoms. Blossoms are attacked by the pathogen even at their first square, but more often when they are open and form good receptacles for moisture. Apparently, pycnospores which may lodge on the open flowers cause infection and subsequent rotting of the petals. Under favorable conditions, the fungus invades the remaining healthy floral tissues and the ovary. Generally, infected blossoms do not continue to develop.

THE CAUSAL ORGANISM

The causal fungus was easily isolated from fresh diseased kenaf leaves and shoots when portions of the infected tissues were plated on potato-dextrose agar plates. After five days, when fungus growth was abundant, transfers were made on agar slants. Subcultures made from these transfers were used in morphological and cultural studies and in inoculation experiments.

Morphology

Mycelium. The fungus produces abundant white mycelium on various culture media. The hyphae are septate and branched (fig. 2A). They are thin-walled, hyaline, and finely granular when young. As they grow older they turn grayish; their walls become thicker and their contents denser. Measurements of 200 hyphal cells from 15-day-old cultures on potato-dextrose agar show that the cells are from 7.0 to 42.9 microns in length and 3.0 to 11.9 microns in width, the average size being $22.71 \pm 0.24 \times 7.95 \pm 0.10$ microns (table 1).

Pycnidia. The pycnidia are partly buried in the medium and in the host tissues. They are globular on agar media and on infected leaves, shoots, and blossoms. Some of them have two ostioles. The pycnidia are light brown when young and grayish black when mature (fig. 3). The cells immediately surrounding the ostiole are much darker in color than the rest of the cells composing the pycnidia. Numerous short, delicate, and hyaline conidiophores are produced inside the pycnidia (fig. 2B). Pycnospores are borne singly on the tips of the conidiophores. The pycnidia are generally solitary and

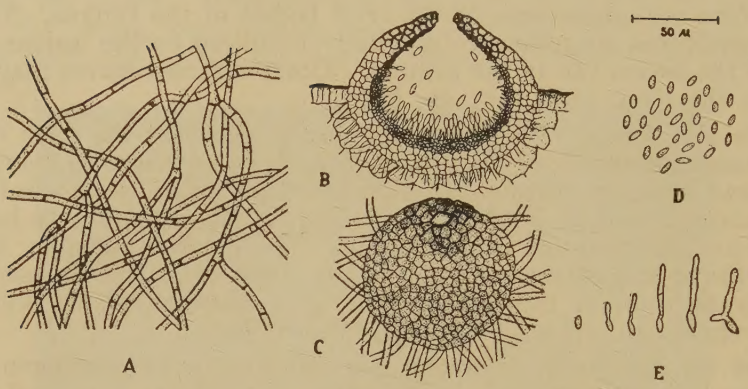

Fig. 2.—Camera lucida drawings: (A) mycelium of *Phoma sabdariffae* taken from a 15-day-old potato-dextrose agar culture, (B) section of a pycnidium showing the arrangement of conidiophores and pycnospores, (C) mature pycnidium, (D) pycnospores, and (E) pycnospores germinating on potato-dextrose agar on glass slides after 12 hours.

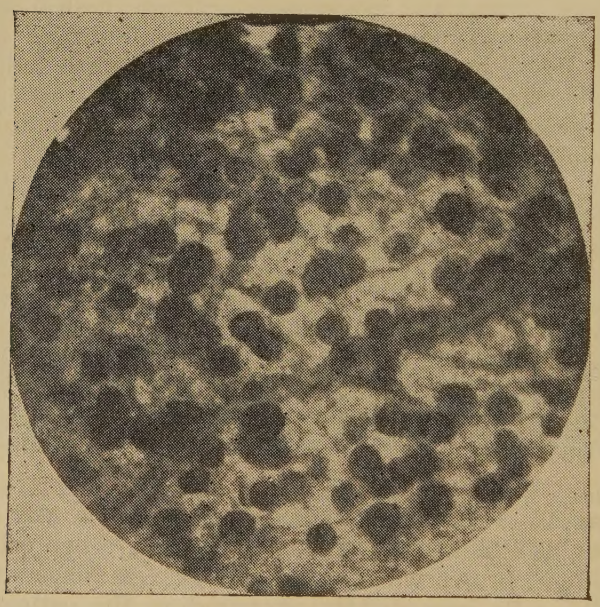

Fig. 3.—Photomicrograph of a decolorized leaf section of kenaf, showing the distribution of pycnidia on the lesion (×30). *Photographed by Dr. J. Banzon, Photographic Division, College of Agriculture.*

are distributed at random on the surface of the infected host tissues. Sometimes, however, they are gregarious, forming groups of two to four. Measurements of 200 pycnidia taken from 15-day-old potato-dextrose-agar cultures show that they are 90 to 189 microns in long diameter and 80 to 179 microns in short diameter, or an average of 129.60 ± 0.82 × 121.60 ± 1.06 microns (table 2). The ostioles are 22.5 to 52.5 microns in diameter, the average diameter being 31.6 microns.

Pycnospores. The pycnospores are ellipsoidal, thin-walled, and hyaline (fig. 2D). They become granular when they germinate. Measurements of 200 pycnospores taken from 15-day-old slant cultures of potato-dextrose agar showed that the length ranges from 7.5 to 16.4 microns and the width, from 3.5 to 7.9 microns, making an average of 12.10 ± 0.96 × 5.96 ± 0.05 microns. Table 3 shows the distribution of 200 pycnospores according to their length and width classes. It can be noted that the length varies considerably, but the width does not. The majority of the pycnospores fall within the length classes 11.0 and 12.9 microns and within the width classes 5.5 and 6.9 microns. Table 4 shows that the greatest number of pycnospores measured had a length-to-width ratio of 2.0 to 2.49.

Physiology

Growth and pycnidial production of the fungus on different agar media. The growth and cultural characteristics and the pycnidial production of the fungus on potato-dextrose agar, malt agar, onion agar, oatmeal agar, nutrient-dextrose agar, kenaf-decoction agar, corn-meal agar, nutrient agar, and water agar are summarized in table 5. The fungus showed comparatively good growth on all of the agar media, except on the nutrient agar and water agar where there was little or no growth observed (fig. 4). The cultural characteristics of the causal organism differed on the various culture media. On the first five culture media, the fungus produced a white fluffy growth within 24 hours. As the culture became older, the white mycelium turned light olive-gray.[3]

Effects of varying hydrogen-ion concentrations on growth and pycnidial production of the fungus. To determine the effects of varying hydrogen-ion concentrations on growth and pycnidial production, the fungus was grown on potato-dextrose agar with pH ranging from 1.4 to 9.4. The agar medium was adjusted to the desired pH by the addition of either N/20 HCl or N/20 NaOH. Triplicate cultures were made for each pH, the pH readings having been determined by a LaMotte colorimeter. All cultures were kept at ordinary room temperature (27°–28°C.). The mycelial growth was measured and the production of pycnidia observed daily.

[3] All colors were named according to Ridgway's color standards. Ridgway, Robert. 1912. Color standards and color nomenclature. iii + 43 p., 53 pl. Washington, D. C.: Robert Ridgway.

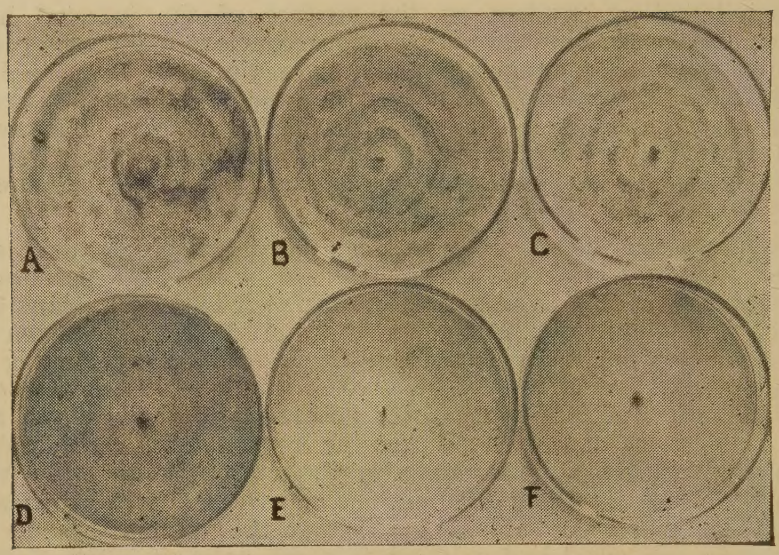

Fig. 4.—Growth and pycnidial production of *Phoma sabdariffae* on various agar media after 8 days: (A) on potato-dextrose agar, (B) on oatmeal agar, (C) on onion agar, (D) on malt agar, (E) on corn-meal agar, (F) on nutrient agar. *Photographed by Dr. J. Banzon, Photographic Division, College of Agriculture.*

The fungus grew better on acidic than on alkaline media (table 6). Mycelial growth was best on the medium with pH 5.4. The differences in mycelial growth and pycnidial production at pH 3.4, 4.4, 5.4, and 6.4 were very slight (fig. 5). Pycnidia were most abundant at pH 4.4, although mycelial growth at this pH was slightly less than those at pH 5.4 and 6.4. At pH 2.4 and 7.4, growth and pycnidial production were fairly abundant. A very slow but compact mycelial growth with no pycnidia was found at pH 1.4 and 8.4. The fungus did not grow at pH 9.4.

Germination of pycnospores

Tap water, distilled water, kenaf decoction, and potato-dextrose agar were used as media for spore germination. Pycnospores were taken from potato-dextrose-agar cultures and mounted in tap water, distilled water, and kenaf decoction in van Tieghem cells and on thin layers of potato-dextrose agar laid on sterilized glass slides. These were observed hourly for the germination of pycnospores.

At laboratory room temperature (27°–28°C.) the pycnospores germinated within 8 to 12 hours on potato-dextrose agar and within 18 to 24 hours in tap water, distilled water, and kenaf decoction. One hyaline germ tube was produced usually at either end of the pycnospore (fig. 2E). Some pycnospores, however, produced branched germ tubes.

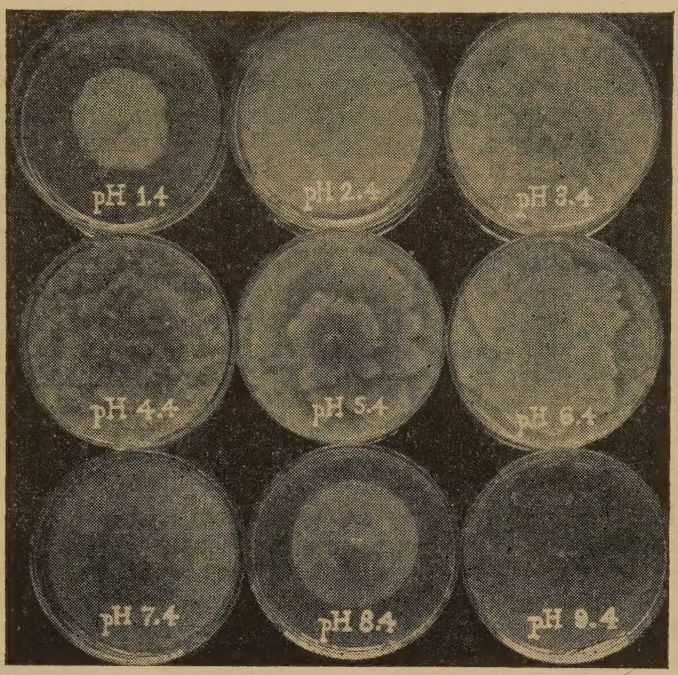

Fig. 5.—Growth and pycnidial production, after 6 days, of *Phoma sabdariffae* on potato-dextrose agar with pH ranging from 1.4 to 9.4. *Photographed by Dr. J. Banzon, Photographic Division, College of Agriculture.*

Viability of the fungus

The viability of the pycnospores produced on diseased leaves and on agar cultures was observed monthly. Infected leaves were placed in a cotton-plugged glass jar and kept in the laboratory along with several slant cultures of potato-dextrose agar. Every month the pycnospores were suspended in sterile distilled water in van Tieghem cells and their germination was observed. Pycnospores which failed to germinate in the van Tieghem cell preparations were transferred to newly prepared potato-dextrose agar slants to further check their viability. It was found that the pycnospores which did not germinate in distilled water also failed to germinate on potato-dextrose agar. The results of these experiments showed that the pycnospores from diseased leaves and shoots remained viable for eight months; those from the agar medium retained their viability for ten months.

Taxonomy

Saccardo [4] described *Phoma sabdariffae* on roselle as producing dense, erumpent, globular pycnidia which are 150 to 180 microns in

[4] SACCARDO, P. A. 1884. Sylloge Fungorum. Vol. 8. 860 p. Ann Arbor, Michigan: Edwards Brothers, Inc.

diameter, with non-elevated ostioles 14 to 16 microns in diameter. The hyaline pycnospores are 12 to 14 × 4 to 4.5 microns in size and are borne on short, papilliform conidiophores.

The writers found that in the Philippines pycnidia of the *Phoma* on kenaf are also erumpent, globular, 80 to 189 microns in diameter, each with an ostiole ranging from 22.5 to 52.5 microns in diameter. The conidiophores are short, delicate, and hyaline. They bear single pycnospores which are ellipsoidal and hyaline and are 7.5 to 16.4 × 3.5 to 7.9 microns in size.

Pycnidia of *Phoma* on kenaf have a wider range of diameter than those of *Phoma sabdariffae* reported by Saccardo in 1884.[5] The writers' measurements of the pycnospores of the kenaf fungus, however, agreed closely with those of Saccardo. The discrepancies in size of pycnidia and pycnospores might have been due to various causes. In the first place, Saccardo's measurements were based on dry materials, whereas those of the writers were based on fresh specimens. Furthermore, the locality from which the fungus was collected, the weather conditions during growth and sporulation of the organism, and the number of structures measured influence the size of pycnidia and pycnospores. For instance, in the case of kenaf fungus, the writers noted variations in the size of pycnidia and pycnospores produced on agar media and on host tissues. In the opinion of the writers, therefore, the discrepancies reported in this paper and those reported by Saccardo do not carry much taxonomic significance. The fact that the fungus examined by the writers causes a disease of kenaf does not warrant its segregation from *Phoma sabdariffae* Sacc. attacking roselle, since the kenaf fungus readily infects roselle and produces symptoms which are similar to those produced by *Phoma sabdariffae* on roselle (Reinking).[6] If distinction between the two organisms must be made, the erection of a new variety for the kenaf fungus would probably be sufficient. For the present, the writers tentatively consider the fungus causing kenaf blight as similar to, if not identical with, *Phoma sabdariffae* Sacc.

PATHOGENICITY

To test the pathogenicity of the fungus, kenaf plants at different stages of development were inoculated. In all the inoculation experiments, two varieties were used, namely, *Hibiscus cannabinus* Linn. var. *vulgaris* and *Hibiscus cannabinus* Linn. var. *viridis*.

Experiment 1. On January 3, 1952, twenty-four 35-day-old plants of each variety were sprayed with pycnospore-suspension of the fungus which had been grown for 15 days on potato-dextrose agar slant. Twelve plants were pricked slightly with sterilized pins to simulate the punctures of insects. The rest were not injured. Sixteen plants of each variety, eight of which were also pin-pricked,

[5] *Ibid.*

[6] Reinking, Otto A. 1918. Philippine economic-plant diseases. Philippine Jour. Sci. 8, Sec. A: 165-274. *Pl. 1-22, fig. 1-43.*

were sprayed with sterile water to serve as control. The inoculated plants, as well as the control, were placed in the damp chamber for 48 hours and afterwards placed under the shade for further observation. No infection was noted on both the inoculated and control plants during the whole period of observation.

Experiment 2. On March 2, 1952, forty 25-day-old kenaf seedlings were inoculated with pycnospore-suspension of the fungus. Twenty plants were used as control. The plants were given the same treatment as that used in experiment 1. Again no infection was observed on the inoculated plants and the control.

Experiment 3. On September 1, 1952, sixty-four 32-day-old plants of each variety were inoculated with bits of agar containing mycelium taken from a 15-day-old culture of the fungus. Twenty-four of the plants of each variety were pin-pricked; the rest were not injured. An equal number of control plants consisting of injured and uninjured individuals was maintained.

After staying 48 hours in the damp chamber, the pricked and unpricked inoculated plants showed symptoms of the disease on the leaves and shoots. When the plants were transferred outside the laboratory, the leaf and shoot lesions continued to develop. The infected leaves eventually fell off, and the infected shoots toppled over.

Experiment 4. On December 1, 1952, forty 20-day-old seedlings of each variety were also inoculated with mycelial fragments. The plants were given the treatment used in the previous experiments before and after inoculation. Control plants were provided. After 48 hours, symptoms of the disease appeared on the pricked and unpricked inoculated plants, but the control remained healthy throughout the period of observation.

Reisolation of the fungus

In every inoculation experiment, the causal fungus was reisolated from infected kenaf leaves and shoots. In all cases, the morphological and cultural characteristics of the reisolated fungus were identical with those of *Phoma sabdariffae* Sacc., the fungus originally used.

Varietal susceptibility and resistance

In the previous inoculation experiments, the two kenaf varieties did not differ in their susceptibility to the disease. The varieties *vulgaris* and *viridis* were easily infected by the fungus. Plants inoculated at different stages of development became either partially or completely defoliated. A number of them died from severe infection. The writers observed that even the new varieties of kenaf, such as *H. cannabinus* Linn. var. *simplex, H. cannabinus* Linn. var. *ruber,* and *H. cannabinus* Linn. var. *purpureus,* were as susceptible as the two varieties mentioned above.

Host range

Cross-inoculation experiments were conducted to determine whether or not the pathogen would infect plants other than kenaf. The following species of plants belonging to four families were tested: Malvaceae—roselle (*Hibiscus sabdariffa* Linn.), okra (*Abelmoschus esculentus* [L.] Moench.), malvas (*Abutilon indicum* [L.] G. Don.), kulotkulotan (*Urena lobata* Linn.), escoba (*Sida acuta* Burn.); Tiliaceae—jute (*Corchorus capsularis* Linn. and *C. acutangulus* Lam.); Bombacaceae—kapok (*Ceiba pentandra* [L.] Geartn.); Sterculiaceae—cacao (*Theobroma cacao* Linn.), abroma (*Abroma augusta* [L.] L.F.).[7] These plants were grown in potted soil and inoculated with bits of agar containing mycelium of the fungus. All other treatments given to the plants were the same as those employed in previous inoculation experiments. Control plants for each species were provided.

Of the ten species used, roselle proved highly susceptible to the disease. Lesions produced on the leaves and shoots of this plant were similar to those produced on kenaf. Even when the plants were transferred outside the laboratory, the lesions continued to develop as they did on kenaf, and later on infected leaves fell off. The rest of the species, both injured and uninjured, were not infected although they were kept longer in the damp chamber and were repeatedly inoculated.

LIFE HISTORY OF THE CAUSAL FUNGUS IN RELATION TO PATHOGENESIS

Seasonal occurrence of the disease

The writers observed that the disease is more prevalent and more severe during the rainy season. The weather conditions in Los Baños during the months of August, September, and October appear to be most favorable for the development of the disease. The dry-season crop is only slightly affected by the disease.

Methods of dissemination of the fungus

By wind. On October 18, 1952, eight Petri dishes containing sterile potato-dextrose agar were exposed in the field. Six plates were exposed for 30 minutes against the wind; two plates each were placed at distances of two, four, and six meters from the leeward edge of a plot of infected kenaf. The remaining two plates were carried around the field for 15 minutes. After exposure, the plates were incubated in the laboratory at room temperature (27°–28°C.). After two days, typical colonies of *Phoma sabdariffae* were observed on all of the exposed dishes. The dishes which were carried around the field and those placed two meters away from infected plants had the most growth. The results indicate that spores of the fungus can be disseminated by wind.

[7] Identified by Mr. J. V. Pancho of the Department of Agricultural Botany.

By insects. To verify whether or not insects found on kenaf plants help disseminate the pycnospores of the fungus, about one hundred and fifty individuals of *Monolepta bifasciata* Horns [8] were collected from diseased kenaf plants in the field. About half of this number were allowed to crawl for six hours over sterile plated potato-dextrose agar and afterwards removed. The rest were placed in a test tube of sterile distilled water which was shaken in order to dislodge the spores that the insects might carry. Small amounts of the water were poured over plates of potato-dextrose agar. The plates were incubated at room temperature and observed for the appearance of fungus colonies. After six days, growths of various fungi appeared on all plates. *Phoma sabdariffae,* with its typical pycnidia, was among the fungi observed on the plates. From the results of this experiment, the writers conclude that insects aid in the dissemination of the fungus.

By seeds. On November 12, 1952, seeds from diseased kenaf capsules were divided into two lots. The seeds in the first lot were disinfected by being immersed in a 1:1000 solution of mercuric bichloride for five minutes and washed in sterile water. Those in the second lot were not disinfected. The treated and untreated seeds were planted separately in pots of sterilized soil and watered regularly. From the time of emergence, the plants were observed daily for the appearance of the disease. Ten days after emergence, symptoms were noted on some of the plants from the untreated seeds. No disease appeared on the plants from the treated seeds. After one month, these plants were still healthy. The results of this test indicate that the fungus can be disseminated by seeds produced in infected capsules.

Method of tiding over from season to season

Infected leaves and shoots and even entire kenaf plants unfit for fiber extraction are usually left in the field after harvest. These plant remains contain abundant pycnidia and mycelium of the fungus. In the absence of kenaf in the field, the pycnospores within the pycnidia and the mycelium within the disintegrating host tissues in the soil may remain dormant or may exist as saprophytes. They serve as sources of inoculum for kenaf plants in the next growing season.

Mode of infection

It has been pointed out that injuries on the host are not necessary for infection. Results of inoculation experiments showed that the disease could be produced independently of wounds as long as enough moisture was present during the incubation period. Infection, however, was more readily secured when the inoculum was applied on injured portions of the leaves and shoots of the plant. The writers believe that in the field, infection takes place largely through leaf and shoot injuries caused by insects and other agents.

[8] Identified by Dr. S. M. Cendaña of the Department of Entomology.

CONTROL MEASURES

Crop rotation

Inasmuch as the fungus can live on decaying plant remains for six to eight months or possibly longer, a 2- to 3-year crop rotation is suggested as a preventive measure against the disease. Both the white and the red varieties of roselle were found susceptible to the disease; therefore, roselle should never be planted before or after kenaf is planted in the field.

Sanitation

Strict sanitary measures will greatly minimize infection of new crops. After harvest, all infected plants and plant remains should be gathered and burned to eliminate sources of inoculum for the next kenaf crop.

Selection and disinfection of seeds

Seeds used for planting should come from healthy plants. If they are taken from an unknown source, they should be disinfected with a solution of mercuric bichloride (1:1000) for at least five minutes and washed in two or more changes of sterile water. Kenaf seeds for the next planting season should be cleaned and kept in a closed container to avoid contamination.

Preliminary test on the use of fungicides

An experiment was conducted in the laboratory to determine the effectiveness of two commercial fungicides against *Phoma sabdariffae*. The two fungicides were "530 Spraycop," a basic copper fungicide containing 53.0 per cent basic copper sulfate equivalent to metallic copper and 47.0 per cent inert ingredients, and "Fermate," an organic fungicide based on ferric dimethyl dithiocarbonate. Manzano (1951)[9] found "Fermate" effective in reducing the damage caused to kenaf plants by the disease.

The results of the writers' experiment showed that the applications of "530 Spraycop" at 2.0 to 3.0 per cent concentrations and "Fermate" at 0.2 to 2.0 per cent concentrations were all effective against the fungus. It should be pointed out, however, that the experiment was carried out on a very limited scale under laboratory conditions, and the results obtained need further verification. Another experiment conducted on a larger scale under actual field conditions is necessary before a definite recommendation for the control of kenaf blight with the above fungicides can be made.

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[9] MANZANO, TOBIAS B., *op. cit.*

TABLE 1

Distribution of lengths and widths of 200 hyphal cells of Phoma sabdariffae

LENGTH CLASS IN MICRONS	NUMBER OF HYPHAL CELLS	WIDTH CLASS IN MICRONS	NUMBER OF HYPHAL CELLS
7.0–8.9	4	3.0–3.9	7
9.0–10.9	5	4.0–4.9	18
11.0–12.9	6	5.0–5.9	31
13.0–14.9	8	6.0–6.9	35
15.0–16.9	17	7.0–7.9	64
17.0–18.9	19	8.0–8.9	25
19.0–20.9	21	9.0–9.9	9
21.0–22.9	26	10.0–10.9	7
23.0–24.9	21	11.0–11.9	4
25.0–26.9	20	—	—
27.0–28.9	20	—	—
29.0–30.9	11	—	—
31.0–32.9	9	—	—
33.0–34.9	4	—	—
35.0–36.9	4	—	—
37.0–38.9	2	—	—
39.0–40.9	2	—	—
41.0–42.9	1	—	—

Average size of hyphal cells = $22.71 \pm 0.24 \times 7.95 \pm 0.10\mu$

TABLE 2

Distribution of long diameters and short diameters of pycnidia of Phoma sabdariffae

LONG DIAMETER CLASS IN MICRONS	NUMBER OF PYCNIDIA	SHORT DIAMETER CLASS IN MICRONS	NUMBER OF PYCNIDIA
90–99	4	80–89	1
100–109	11	90–99	16
110–119	28	100–109	24
120–129	52	110–119	40
130–139	66	120–129	73
140–149	25	130–139	24
150–159	11	140–149	13
160–169	1	150–159	5
170–179	1	160–169	3
180–189	1	170–179	1

Average size of pycnidia = $129.60 \pm 0.82 \times 121.60 \pm 1.06\mu$

TABLE 3

Distribution of lengths and widths of 200 pycnospores of Phoma sabdariffae

LENGTH CLASS IN MICRONS	NUMBER OF PYCNOSPORES	WIDTH CLASS IN MICRONS	NUMBER OF PYCNOSPORES
7.5–7.9	1	3.5–3.9	2
8.0–8.4	1	4.0–4.4	3
8.5–8.9	1	4.5–4.9	15
9.0–9.4	2	5.0–5.4	27
9.5–9.9	4	5.5–5.9	60
10.0–10.4	7	6.0–6.4	43
10.5–10.9	13	6.5–6.9	27
11.0–11.4	29	7.0–7.4	12
11.5–11.9	36	7.5–7.9	11
12.0–12.4	38	—	—
12.5–12.9	22	—	—
13.0–13.4	17	—	—
13.5–13.9	13	—	—
14.0–14.4	6	—	—
14.5–14.9	5	—	—
15.0–15.4	2	—	—
15.5–15.9	2	—	—
16.0–16.4	1	—	—

Average size of pycnospores = $12.10 \pm 0.96 \times 5.96 \pm 0.05\mu$

TABLE 4

Ratios of length to width of 200 pycnospores of Phoma sabdariffae distributed in classes made by a difference of 0.5

RATIO CLASS	NUMBER OF PYCNOSPORES
1:	
1.00–1.49	2
1.50–1.99	41
2.00–2.49	130
2.50–2.99	24
3.00–3.49	3

Average ratio = 2.13

TABLE 5

Growth characteristics and pycnidial production of Phoma sabdariffae on various agar media

MEDIA	GROWTH CHARACTERISTICS	PRODUCTION OF PYCNIDIA	DIAMETER OF COLONY AFTER 6 DAYS *	AVERAGE DAILY GROWTH
			mm.	*mm.*
Potato-dextrose agar	Very abundant, white to dull-white mycelium produced within 24-48 hours; cultural medium changed from pale pinkish buff to pinkish buff.	Very abundant	67.00 ± 8.83	11.16 ± 1.47
Oatmeal agar	Very abundant mycelium produced within 24-48 hours; varying from white to dull white; cultural medium changed from milky white to neutral gray.	Very abundant	56.16 ± 7.61	9.36 ± 1.27
Onion agar	Fairly abundant, whitish to dull-white mycelial growth produced within 24-48 hours; cultural medium changed from pale olive-buff to tilleul-buff.	Fairly abundant	47.33 ± 6.01	7.89 ± 1.00
Malt agar	Abundant aerial mycelial growth, white to neutral gray produced within 2-3 days; cultural medium changed from light cinnamon-drab to cinnamon-drab.	Very abundant	50.33 ± 5.82	8.39 ± 0.97
Corn-meal agar	Very thin, white to neutral gray growth produced within 2-3 days; cultural medium changed from pale brownish vinaceous to vinaceous buff.	Very scarce	52.83 ± 6.17	8.81 ± 1.03
Nutrient-dextrose agar	Fairly abundant, white to dull-white mycelial growth produced within 24-48 hours; cultural medium changed from light vinaceous-fawn to vinaceous-buff.	Scarce	52.34 ± 12.28	8.72 ± 2.05
Kenaf-decoction agar	Fairly abundant, whitish to dull-white mycelial growth produced within 2-3 days; cultural medium changed from pale olive-buff to tilleul-buff.	Fairly abundant	45.66 ± 7.27	7.61 ± 1.21
Nutrient agar	Scarce, white to dull-white mycelial growth produced within 2-3 days; cultural medium changed from pale brownish drab to light cinnamon-drab.	None	20.00 ± 1.78	3.33 ± 0.30
Water agar	No growth produced.	None	—	—

* Average of four cultures.

TABLE 6

Growth and pycnidial production of Phoma sabdariffae on potato-dextrose agar of different hydrogen-ion concentrations

pH OF MEDIA	RELATIVE ABUNDANCE OF MYCELIUM	RELATIVE ABUNDANCE OF PYCNIDIA	DIAMETER OF COLONY AFTER 6 DAYS *	AVERAGE DAILY GROWTH
			mm.	*mm.*
1.4	Very scarce	None	28.36 ± 0.57	4.73 ± 0.10
2.4	Fairly abundant	Very scarce	55.20 ± 8.52	9.20 ± 1.42
3.4	Abundant	Abundant	79.38 ± 5.50	13.23 ± 0.91
4.4	Very abundant	Very abundant	71.70 ± 11.03	11.95 ± 1.83
5.4	Very abundant	Abundant	66.10 ± 6.74	11.06 ± 1.12
6.4	Abundant	Fairly abundant	56.40 ± 10.48	9.40 ± 1.74
7.4	Fairly abundant	Scarce	54.50 ± 8.69	9.08 ± 1.44
8.4	Very abundant	None	51.17 ± 10.45	8.53 ± 1.74
9.4	None	None	—	—

* Average of three cultures.

A TEST OF FOUR GREEN-MANURE CROPS FOR CORN [1]

ROMUALDO V. EUSEBIO AND DIOSCORO L. UMALI

Mungo, tapilan, soybean, and cowpea were grown as green manures in plots subsequently planted to corn. In the first succeeding corn crop, the plants in the green-manured plots were distinctly darker green than those in the control plots, which had been continuously planted only to corn. The cowpea, mungo, and tapilan treatments increased the yield significantly more than did the control; the three legumes were equally good as green manures for corn. The effect on corn yield of the soybean treatment and of fallowing was insignificant.

In the second succeeding crop of corn, the yield of the plots previously planted to cowpea was significantly more than that of any of the plots previously planted to the other legumes or of the control. All the treatments, with the exception of cowpea, had insignificant effects on the corn yield.

Green manuring is an effective way of maintaining the productivity of the soil. It replenishes the supply of organic matter in the soil, checks erosion, reduces losses from leaching, increases the water-holding capacity of light soils, and makes heavy soils porous. The spreading out in the topsoil of the roots of green-manure crops and their penetration into the subsoil in search of nutrient substances result in the accumulation of plant food material which becomes available to the cash crop when the manurial crop is turned under. Green manuring with legumes adds nitrogen to the soil because the nodule bacteria absorb free nitrogen and change it into a form that the plant can use.

Hutcheson and Wolfe [2] said that although a green-manure crop has been shown to have a marked residual value, its exact worth has not been worked out. Pieters [3] concluded that the greatest response is observed in crops like corn and that for such crops green manures are to be recommended.

The residual value of various green manures to the succeeding crops is a promising field for further investigation; hence, this study on the influence of mungo, tapilan, soybean, and cowpea on the yield of two succeeding crops of corn was conducted from November, 1951, to February, 1953, at the Experiment Station of the College of Agriculture and in the Plant Breeding Laboratory of the Department of Agronomy.

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[1] Central Experiment Station Contribution No. 1679. Thesis presented by the senior author for graduation with the degree of Bachelor of Science in Agriture from the College of Agriculture. Prepared in the Department of Agronomy under the direction of the junior author.

[2] HUTCHESON, T. B., AND T. K. WOLFE. 1924. The production of field crops. xv + 499 p. New York: McGraw-Hill Book Co., Inc.

[3] PIETERS, A. J. 1927. Green manuring. xiv + 356 p. New York: Wiley and Sons.

MATERIALS AND METHODS

The four green manures used in this experiment were mungo (*Phaseolus aureus* Roxb.), yellow variety; soybean (*Glycine max* Linn.), variety Mis 28 EB; and cowpea (*Vigna sinensis* Linn.), New Era variety. In all the plantings of corn the College Yellow Flint variety was used.

A lot of approximately 4,500 square meters, which had been planted to corn continuously for three years, was divided into 30 plots of 10 by 12 meters each. Six plots made up a replication: one plot was fallowed, one was planted again to corn and designated the control, and the remaining four were planted to the four green-manure crops. A planting space of one meter between plots in the replication and one and a half meters between replications was provided. There were five replications in all in a randomized block design.

The green-manure crops

Ten furrows, 75 centimeters apart, were made in every plot, with the exception of the plots to be fallowed. On December 30, 1951, three to four seeds of each of the green-manure crops were dropped in a hill; the hills were spaced 20 centimeters apart. The same number of seeds of corn was planted to a hill in the control plots, but the distance between hills was 70 centimeters.

The first cultivation was done when the plants were three weeks old. The green-manure and corn plants were thinned to two to a hill after the first cultivation. The plants were hilled-up when they were four weeks old. The fallowed plots were left untouched and the weeds were allowed to grow unchecked.

At blooming time of the various green manures, 20 two-plant hills were dug up at random and immediately weighed separately. The plants of each green-manure crop were sun-dried to a constant weight. The percentage of dry matter for each green manure was determined.

The green-manure crops were plowed under at the height of their blooming period. On February 17 and 18, the mungo and soybean plots were turned under with a native plow, and on February 21 and 22, the tapilan and cowpea plots were likewise turned under. A grub hoe was used to cover the exposed uprooted plants in each plot. The fallowed plots, where the weeds grew luxuriantly, were left untouched.

The first observation on the degree of decomposition was made 15 days after the green-manure crops had been plowed under; the second observation, 30 days after; the third, 45 days after; and the fourth and last observation, 60 days after. Ten spots in each plot were dug at random and the decomposition of the plants therein was observed. Each spot was marked so that later observations could be made on the same place and on the same plant materials.

The corn crop in the control plots was allowed to mature and was harvested.

The succeeding corn crops

First succeeding crop (wet season, 1952). The land was plowed twice and harrowed after each plowing. Nine furrows, one meter apart, were made in each plot. On May 18, three seeds of College Yellow Flint were planted in each hill; the distance between hills was 70 centimeters.

Two weeks after planting, each hill was thinned to two plants. The plants were cultivated when three weeks old and hilled-up when four weeks old.

On September 3, 1952, the corn crop was harvested. Ten plants were picked from each of the five middle rows for yield comparison. Ears were harvested only from two-plant hills surrounded by other hills with complete stand. The harvest from each plot was dried to constant weight under the sun and shelled.

Second succeeding crop (dry season). After the harvest of the first succeeding crop, the land was cleared of stalks, plowed twice, and harrowed after each plowing. Nine furrows, 90 centimeters apart, were made in each plot. On November 29, three to four seeds of College Yellow Flint were dropped in a hill; the distance between hills was 70 centimeters. Two weeks after planting, the plants were thinned to two to a hill. The first cultivation was done when the plants were four weeks old, and hilling-up, when they were five and a half weeks old.

On February 21, 1953, the second succeeding crop was harvested in the same manner as the first. The harvest from each plot was dried separately under the sun, shelled, and weighed. Only four replications were harvested in the second succeeding crop because the stand of plants in one replication was poor.

RESULTS AND DISCUSSION

Field observations

On the green-manure cultures. The four legume crops emerged four to eight days after planting. The average number of days from planting to blooming of the different legumes was 46 for mungo, 48 for soybean, and 50 for tapilan and cowpea. In growth the cowpea plants were most vigorous; the tapilan plants were second; and the soybean plants, third. Mungo, although distinctly darker green than the other green-manure crops, was the least vigorous in growth.

On the succeeding crops. In the first succeeding corn crop, emergence was observed from the sixth to the tenth day after planting. The rate of emergence was about the same in all the plots. During the growing period, the corn plants in the green-manured plots were more vigorous and darker green than those in the control

plots. Tasseling was observed when the plants were eight weeks old, and silking, two to four days later.

In the second succeeding crop, emergence was observed earlier but over a wider range of days; the seedlings emerged from five to twelve days after planting. The extended time of emergence of some of the seedlings could have been due to the heavy rains after planting; in fact, the plants in two plots of the fifth replication were badly stunted so that this replication had to be discarded later.

Tasseling was observed seven weeks after planting; silking, two to three days later.

Fresh weight, dry weight, and percentage of dry matter of the green-manure crops

Cowpea had the highest average fresh and dry weights, and mungo had the poorest (table 1). This result is to be expected since cowpea had a more vigorous growth than mungo during the growing period. It does not always follow, however, that the more the fresh weight, the more the dry weight, for tapilan, which was second in average fresh weight, ranked third in average dry-matter content.

There was considerable variability in percentage of dry matter in the four legumes. Soybean had the highest percentage of dry matter and cowpea had the lowest, an indication that cowpea is more succulent or has more moisture than the others.

Degree of decomposition

Fifteen days after the legumes had been plowed under, they were found to be in the process of rotting. It was observed that the plants that were thinly covered with soil were brittle and brownish, whereas those that were well covered with soil were soft and dark.

Thirty days after they were plowed under, all of the legumes were fairly rotted, with the leaves of the plants being hardly noticeable. Hard portions of the stems of mungo and cowpea plants, however, were still visible.

Forty-five days after plowing under, traces of the stem parts of mungo and cowpea plants could still be seen.

Sixty days after plowing under, no trace of any plant part could be found in any of the green-manured plots.

Yield performance of the succeeding corn crops

Table 2 shows the effects of the different treatments on the yield of the first succeeding crop of corn. The analysis of variance shows a highly significant difference in the yields of the various treatments. Considering the mean difference at the 5 per cent level, cowpea, mungo, and tapilan treatments gave significantly better yields of

corn than the control. As shown by their individual increases in yield over the control, the three legumes were equally good as green manures. The effect of soybean and of fallowing on the yield of corn, however, was insignificant.

Although cowpea, which had the highest average yield of dry matter, increased the yield most in the first succeeding crop of corn, the results showed that the yield is not always influenced by the amount of dry matter turned in. Mungo, which had the lowest average yield of dry matter, was second in increasing the yield of corn; soybean, which was second in average yield of dry matter, did not significantly increase the yield over the control.

Aquino and Madamba [4] noted that the more the root nodules, the higher the gain in nitrogen. There is then the possibility of more root nodule formation and, consequently, more nitrogen in some green manures than in others.

In the second succeeding crop of corn, although all the green manures and the fallowed treatment increased the yield of corn more than did the control, only cowpea increased the yield significantly (table 3). The yield of the plots previously planted to cowpea was significantly better than that of the control or of any of the plots previously planted to the three green manures or of the fallowed treatment. In both test crops, cowpea always increased the yield most; soybean and the fallowed treatment increased the yield least. Unlike mungo and tapilan which significantly increased the yield of corn only in the first succeeding crop, cowpea, which had the most fresh and dry weights for a given area, maintained its beneficial residual effect up to the second succeeding crop of corn.

[4] AQUINO, D. I., AND A. L. MADAMBA. 1939. A study of root nodule formation of certain leguminous plants. Philippine Agriculutrist 28: 121-132.

TABLE 1

Fresh weight, dry weight, and percentage of dry matter of the green-manure crops [a]

GREEN MANURE	FRESH WEIGHT						DRY WEIGHT						PERCENTAGE OF DRY MATTER					
	Replication						Replication						Replication					
	1	2	3	4	5	Av.	1	2	3	4	5	Av.	1	2	3	4	5	Av.
	gm.	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	*gm.*	%	%	%	%	%	%
Mungo	360.5	355.7	364.6	415.1	296.7	358.5	119.2	107.3	119.7	129.2	110.7	117.2	33.1	30.2	32.8	31.1	37.3	32.7
Soybean	562.1	468.1	684.9	691.4	594.5	600.2	191.4	160.4	232.0	225.8	223.7	206.7	34.1	34.3	33.9	32.7	37.6	34.4
Cowpea	1415.3	843.5	920.2	1307.9	611.9	1019.8	321.7	189.1	207.2	269.1	150.6	227.5	22.7	22.4	22.5	20.6	24.6	22.3
Tapilan	500.2	495.9	458.2	628.8	924.6	601.5	143.0	125.2	131.4	155.6	217.1	154.5	28.6	25.2	28.7	24.7	23.5	25.7

[a] Based on 20 two-plant hills picked at random from each plot.

TABLE 2

Yield of the first succeeding crop of corn in the different treatments[a]

TREATMENT	REPLICATION					TOTAL	MEAN	PERCENTAGE INCREASE IN YIELD
	1	2	3	4	5			
	grams	*grams*	*grams*	*grams*	*grams*	*grams*	*grams*	*per cent*
Soybean	5,843	4,840	5,205	5,669	5,342	26,899	5,379.8	9.39
Tapilan	6,504	5,283	5,626	4,861	5,421	27,695	5,539.0	12.62
Cowpea	5,528	5,673	5,584	5,968	6,731	29,484	5,896.8	19.90
Mungo	6,070	5,453	5,755	5,702	5,345	28,325	5,665.0	15.19
Fallowed	5,622	4,732	5,490	5,037	5,283	26,164	5,232.8	6.40
Control	5,379	4,653	5,101	4,966	4,491	24.590	4,918.0	—

L.S.M.D. = 495.76

[a] Fifty plants were harvested from each plot.

Analysis of variance

SOURCE	DF	SS	VARIANCE	COMPUTED VALUE F	TABULAR F-VALUE		REMARKS
					.05	.01	
Replications.	4	1,591,274					
Treatments .	5	2,940,599	588,119	4.16	2.71	4.10	Highly significant
Error	20	2,824,119	141,205				
Total	29	7,355,992					

TABLE 3

Yield of the second succeeding crop of corn in the different treatments[a]

TREATMENT	REPLICATION				TOTAL	MEAN	PERCENTAGE INCREASE IN YIELD
	1	2	3	4			
	grams	*grams*	*grams*	*grams*	*grams*	*grams*	*per cent*
Soybean	4,395	4,783	4,459	4,608	18,245	4,561.3	5.11
Tapilan	4,825	4,851	4,071	4,661	18,408	4,602.0	6.05
Cowpea	5,207	4,999	5,249	4,887	20,342	5,085.5	17.19
Mungo	5,002	4,502	4,534	4,793	18,831	4,707.8	8.49
Fallowed	4,214	4,453	4,838	4,427	17,932	4,438.0	3.31
Control	4,168	4,522	4,453	4,215	17,358	4,339.5	—

L.S.M.D. = 390.13

[a] Fifty plants were harvested from each plot.

Analysis of variance

SOURCE	DF	SS	VARIANCE	COMPUTED VALUE F	TABULAR F-VALUE		REMARKS
					.05	.01	
Replications.	3	29,426					
Treatments .	5	1,300,140	260,028	3.88	2.90	4.56	Significant
Error	15	1,005,474	67,031.6				
Total	23	2,335,040					

SOME FACTORS AFFECTING ENGAGEMENT IN FARMING OF AGRICULTURAL-SCHOOL GRADUATES [1]

FRANCISCO M. SACAY

Only 10 per cent of the seniors surveyed intended to farm directly after graduation; 96.9 per cent hoped to farm at some future time. The low percentage of those who would farm directly after graduation was due mainly to the lack of land and capital. Given adequate capital or bank loan, 63.8 per cent of the seniors would farm immediately after graduation. The loan needed by the seniors ranged from ₱1000 to over ₱12,000, or an average of ₱5,824.12. Principals of agricultural schools believed that placing graduates on settlement areas, giving them loans, and selecting students on the basis of vocational aptitude would encourage a larger number to engage in farming.

Agricultural educators in this country generally concede that the percentage of graduates and former students of agricultural and rural high schools who engage in farming is not large. It is highly desirable that more of these individuals, who have been equipped with agricultural knowledge and farm skills, enter farming occupations, especially at this time when the country has embarked on a program of increased agricultural production. This study was conducted (a) to determine the principal reasons why a large percentage of individuals who have been trained in vocational schools of agriculture do not engage in farming, (b) to discover ways by which a larger percentage may be encouraged to return to the farm, and (c) to obtain the reaction of students to a system of agricultural loans to finance farming operations.

To secure the necessary data, copies of a questionnaire were sent in 1951 to principals of agricultural and rural high schools. The principals were requested to state the reasons why a number of their graduates did not engage in farming and to suggest ways and means of encouraging more of them to return to the farm. Copies of another questionnaire were sent, one month before their graduation, to the 160 members of the graduating class of one of the best agricultural schools of the Philippines which draws its students from all parts of the country. Copies of this questionnaire were sent through the teachers of farm economics, who were requested to distribute, collect, and return the accomplished forms.

FINDINGS AND DISCUSSION

Occupational plans of seniors

Of the 160 high-school seniors, with an average age of 23.7 years, included in this study, only 16 intended to farm immediately after graduation. All, with the exception of five, planned to engage in

[1] Central Experiment Station Contribution No. 1680.

farming at some future time when conditions were more favorable. This usually meant that they intended to farm when they already had farms and the necessary capital. If given sufficient bank loan, however, 102 seniors would go directly to the farm; 36.2 per cent would pursue other activities.

Of the 144 seniors who would not farm immediately after graduation, 63.2 per cent intended to look for jobs, 25.7 per cent to continue their studies, 6.2 per cent to teach, and 4.9 per cent to study and teach.

Reasons for not farming

Reasons given by the seniors. The seniors gave lack of capital as their principal reason for not going into farming. Of the seniors who did not intend to farm immediately after graduation, 70.8 per cent did not have sufficient land and capital. About 25.7 per cent wanted to pursue further education.

Reasons given by the principals. The most common reasons given by principals of agricultural and rural high schools as to why many of their graduates do not go directly into farming were the following: (a) the graduates or their parents do not possess farms, or the farms are too small to challenge the interest of the graduates; (b) they lack the capital necessary to acquire land, work animals, and implements; (c) homesteading fails to attract the graduates because it requires capital, and the homesteader has to face many difficulties, such as lack of roads, markets, and educational and medical facilities; and (d) some students are not really interested in farming but attend agricultural school only because it is near their homes and permits a poor student to acquire a high-school education with little expense.

Land ownership

Although 86.8 per cent of the fathers of the seniors were engaged in farming, only about two-thirds owned farms. The area owned by 26.2 per cent of the parents who were landowners was less than five hectares each (table 1). The fact that there were, on the average, 6.1 children in a family must also be considered.

Amount of loan desired

The amount of loan needed by the seniors ranged from less than ₱1000 to over ₱12,000 (table 2); 56.2 per cent would need ₱5000 or less. If all of them would farm, they would need loans amounting to ₱931,860, or an average of ₱5,824.12 a person. Of this amount, a major portion, 54.4 per cent, would be used in acquiring land, and the rest, for buildings, tools, work animals, productive livestock, and cash outlay. The last item would amount to ₱1040, or 17.9 per cent.

While a few believed that they could begin amortization payment after the first year, 26.9 per cent preferred to start paying

after the third year, and 36.2 wanted to do so after the fourth or fifth year. Regarding the number of yearly installments, 20.0 per cent wanted 5 years or less; 58.1 per cent, 6 to 10 years. The others wanted a period longer than 10 years.

Type of farming and place

The seniors selected different types of farming, although 59.4 per cent would grow rice as the main crop. Only 3.1 per cent would go into livestock and poultry raising. The choice of 14.4 per cent was corn farming; of 10 per cent, abacá farming; of 4.4 per cent, coconut farming; and of 1.9 per cent, tobacco farming. Corn was chosen by 40.0 per cent as second in importance in the farming program; abacá, by 21.2 per cent; coconut, by 11.2 per cent; and rice, by 7.5 per cent. Vegetables, livestock, dairy, and poultry were chosen by others.

The seniors intended to farm in 17 provinces. Cotabato was chosen by 25 per cent; Davao, by 25 per cent; Isabela, by 15.0 per cent; Palawan, by 5.0 per cent; and Cagayan, by 5.0 per cent. The students tended to select places where vacant lands are available.

Ways of encouraging more graduates to go into farming

To the end that a higher percentage of graduates may engage in farming, the principals offered the following suggestions: give loans to graduates, place graduates on settlement areas or colonies, and select students on the basis of vocational aptitude.

Loans to graduates. Many of the students in vocational schools of agriculture come from poor families. Without loans or financial assistance from a bank or government institution, they will not be able to start a farming business. The seniors, however, expected these loans to be in the nature of character loans, inasmuch as they did not have sufficient security for the amount that they desired.

Placement of graduates on farms. Placement of graduates is done to a certain extent at present, but increased attention to this feature of our settlement program is needed. If, in addition to placement, adequate loans are also given to the graduates, the problems involved in starting a farming business will be greatly minimized.

Selection of students on the basis of vocational aptitude. Students of agricultural schools should be selected on the basis of vocational aptitude. The principals believed that many young men enter vocational schools of agriculture only because such schools are near their homes. Another important reason is that they can acquire secondary education with little expense. They can support themselves while studying, and after graduation, they pursue a college education or look for non-farming jobs.

TABLE 1

Area of land owned by parents of seniors

AREA	NUMBER OF INDIVIDUALS	PERCENTAGE
hectares		
5 or less	42	26.2
6–10	22	13.8
11–15	21	13.1
16–20	5	3.1
21–25	8	5.0
26–30	4	2.5
31 and over	4	2.5
None	54	33.8
Total	160	100.0

TABLE 2

Amount of loan desired by seniors

AMOUNT	NUMBER OF INDIVIDUALS	PERCENTAGE
pesos		
1,000 or less	6	3.8
1,001–2,000	29	18.1
2,001–3,000	18	11.3
3,001–4,000	7	4.4
4,001–5,000	30	18.8
5,001–6,000	12	7.5
6,001–7,000	10	6.2
7,001–8,000	11	6.9
8,001–9,000	5	3.1
9,001–10,000	13	8.1
10,001–11,000	5	3.1
11,001–12,000	2	1.2
12,001 and over	12	7.5
Total	160	100.0

GROWTH AND DRESSING EFFICIENCY OF SEXED SINGLE COMB WHITE LEGHORN AND NEW HAMPSHIRE MALE CHICKS RAISED AS BROILERS [1]

RAUL L. LOPEZ

WITH ONE TEXT FIGURE

The results of this study show that New Hampshire male chicks can be more efficiently raised as broiler birds than S. C. White Leghorns. At twelve weeks, the New Hampshire males averaged 913.9 ± 20.99 kilograms; the S. C. White Leghorns, 791.3 ± 19.25 kilograms. There was not much difference in dressing percentage; it was 72.3 in the New Hampshires and 71.4 in the S. C. White Leghorns. The average mortality of the New Hampshire lot was only 5.0 per cent; that of the S. C. White Leghorn lot, 10.0 per cent. The New Hampshires were more efficient converters of feed. They required only 4.46 kilograms of feed to produce a kilogram gain, whereas the S. C. White Leghorns required 4.99 kilograms. With feed costing ₱0.27 a kilogram and a broiler costing ₱2.50 a kilogram, the New Hampshires gave average returns above feed cost of ₱120.73; the S. C. White Leghorns gave ₱89.78.

To compare the growth and dressing efficiency of sexed Single Comb White Leghorn and New Hampshire cockerels raised as broilers, this study was conducted in the Department of Animal Husbandry from January to November, 1952.

MATERIALS AND METHODS

Two hundred sexed Single Comb White Leghorn and 200 New Hampshire day-old male chicks [2] were obtained from the Santa Fe Farm in College, Los Baños, Laguna, and used in two trials, each covering a period of 12 weeks. The S. C. White Leghorn chicks were designated as lot I, and the New Hampshire chicks as lot II. The birds of each breed were confined in separate pens measuring 2.4 × 1.8 meters and provided with concrete floors with rice hulls as litter. Adjoining each pen was a well-ventilated, electrically heated brooder where the birds were kept during their first few days of life. Each pen was provided with a small yard where the birds could sun themselves.

The birds were leg-banded and weighed a few hours after they were hatched and every week thereafter. On the twelfth week, after their final weights had been taken, the birds were dressed (feathers and entrails removed) and their dressed weights were determined.

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[1] Central Experiment Station Contribution No. 1681. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Animal Husbandry under the direction of Instructor Amado C. Campos.

[2] Because of errors in sexing, 27 (10 in trial 1 and 17 in trial 2) New Hampshire and 25 (10 in trial 1 and 15 in trial 2) S. C. White Leghorn female chicks were included with the males.

The same ration, care, and management were given to the chicks in both lots. The ration consisted of the following ingredients, all parts by weight:

Rice bran	55
Ground corn	20
Fish meal	20
Copra meal	5
	100

To every 100 parts of the mash, one part of table salt and 10 parts of cow manure were added. Finely chopped green feed, ground shells, and grit were made available to the birds soon after they had become two weeks old. After the eighth week, one-half of the mash was replaced by ground corn.

Records were kept of the initial and weekly weights of the chicks, the amount and cost of the feed consumed, the rate of mortality, and other observations made during the experiment.

RESULTS AND DISCUSSION

Rate of growth. In both lots the weekly weights of the chicks were used as a measure of their rate of growth. Except for the slight advantage in initial weight of lot I over lot II during the second and third weeks of trial 2, lot II was consistently superior to lot I throughout the twelve-week period of observation (table 1 and fig. 1). The greatest gain in weekly weight of both lots, which was made from the ninth to the twelfth week, corroborates the findings of Kempster.[3] At the end of the twelfth week, the birds in lot I had attained an average live weight of only 791.3 ± 19.25 grams and gave an average dressed weight of 564.9 ± 15.71 grams; those in lot II had an average live weight of 913.9 ± 20.99 grams and an average dressed weight of 663.0 ± 17.22 grams. These figures indicate a difference of 122.6 grams in live weight and 98.1 grams in dressed weight in favor of the New Hampshire lot. The difference in dressing percentage between the cockerels of both breeds was slight; lot I gave an average dressing percentage of 71.4, and lot II, 72.3.

In this experiment, the live weight of the broilers was lower than that reported by Kempster. The S. C. White Leghorn cockerels in Kempster's study had a live weight of 1 kilogram (2.20 pounds); the New Hampshire cockerels, 1.03 kilograms (2.26 pounds). The figures obtained in the present study, however, were much higher than the 0.604 kilogram for S. C. White Leghorn and 0.571 for New Hampshire reported by Mondoñedo.[4]

[3] KEMPSTER, H. L. 1941. The growth of pullets and cockerels. Missouri Agric. Exper. Sta. Bull. 423: 1–20.

[4] MONDOÑEDO, J. R. 1950. Production of broilers from New Hampshire, Los Baños Cantonese, and Single Comb White Leghorn breeds of poultry. Philippine Agriculturist 34: 49–53.

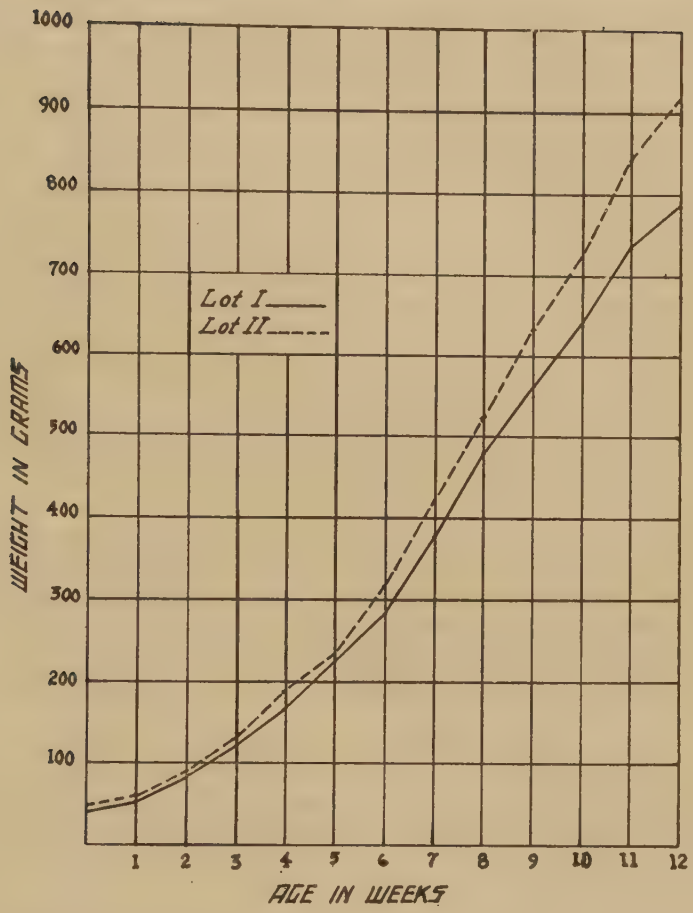

Fig. 1.—Mean weekly weights of the chicks in the two lots.

The dressing percentage of both breeds in this study was somewhat lower than that reported from abroad. Rosenberg and Murata [5] stated that the percentage of live weight lost through evisceration of 14-week-old male New Hampshire chicks with an average live weight of 2.53 kilograms (5.15 pounds) was 27.30 per cent, and that of New Hampshire–Rhode Island Red 12-week-old crossbreds weighing 1.81 kilograms (4.17 pounds) was 25.66 per cent. Blow and Glazener [6] found that New Hampshire cockerel broilers weighed 1.88 kilograms when approximately 11 weeks old and 1.43 kilograms when eviscerated; there was a loss of 21.21 per cent through evisceration.

[5] Rosenberg, M. M., and K. Murata. 1950. Factors in the preparation of fryers and roasters for market. Poultry Marketing Studies Cir. 34: 1–10.

[6] Blow, L. W., and E. W. Glazener. 1952. The appraisal of conformation in broilers. Poultry Science 31: 654–658.

Feed consumption and cost. As shown in table 3, the New Hampshire lot consumed more feed than the S. C. White Leghorn lot. The feed consumed by lot I averaged 335.20 kilograms and cost ₱88.19; that consumed by lot II averaged 366.89 kilograms and cost ₱96.34. The corn alone added to the feed after the eighth week amounted to 76.94 kilograms (₱18.46) in lot I and 90.65 kilograms (₱21.76) in lot II; the mash amounted to 258.26 kilograms (₱69.73) in lot I and 276.24 kilograms (₱74.58) in lot II. Each bird in lot I consumed an average of 3.72 kilograms of feed, and each bird in lot II, 3.86 kilograms. Ewing [7] reported that an average live weight of 0.906 kilogram (2.0 pounds) was attained by White Leghorns at 9.5 to 12.3 weeks of age and by Rhode Island Reds at 9.2 to 11.9 weeks of age. White Leghorns required 3.27 kilograms (7.2 pounds) of feed; Rhode Island Reds, 2.59 kilograms (5.7 pounds). In terms of efficiency in utilizing the feed, lot II birds proved better than those in lot I since they consumed only 4.46 kilograms (costing ₱1.17) to produce a kilogram gain, whereas those in lot I consumed 4.99 kilograms (costing ₱1.32).

Being more efficient feed consumers, the New Hampshires had more kilograms of live weight (an average of 86.83 kilograms) than the Single Comb White Leghorns (71.19 kilograms). More returns were obtained from the sale of the New Hampshire broilers. The average actual returns above feed cost from the sale of the broilers were ₱120.73 for the New Hampshires and ₱89.78 for the S. C. White Leghorns.

Mortality. Of the 400 chicks used in both trials at the start of the experiment, 180 survived in lot I and 190 in lot II (table 2). Nine birds in the S. C. White Leghorn lot died in the first trial and 11 in the second; in the New Hampshire group, 5 birds died in the first trial and another 5 in the second. Diseases like cecal coccidiosis and roup were the serious causes of deaths.

Other observations. There were pinfeathers on almost all of the dressed New Hampshire and Single Comb White Leghorn broilers; however, there were more on thin birds than on healthy ones.

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[7] EWING, R. W. 1951. Poultry nutrition. 4th ed. (revised), 1464 p. South Pasadena, California.

TABLE 1

Average initial and weekly weights and average dressed weight and dressing percentage of S. C. White Leghorn and New Hampshire cockerels

AGE IN WEEKS	LIVE WEIGHT					
	Trial 1		Trial 2		Mean	
	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II
	grams	*grams*	*grams*	*grams*	*grams*	*grams*
Initial	38.0	39.6	42.1	40.2	40.1	39.9
1	50.2	56.1	51.4	59.9	50.8	58.0
2	75.3	99.9	88.3	83.8	81.8	91.9
3	129.9	139.8	131.8	126.1	130.9	131.9
4	167.0	193.3	172.6	178.1	169.8	185.7
5	221.9	236.7	241.7	244.9	231.8	240.8
6	301.5	348.0	313.4	322.8	307.5	335.4
7	382.6	450.4	398.7	417.6	390.7	434.0
8	472.6	528.7	488.2	515.1	480.4	521.9
9	561.5	647.5	567.8	629.8	564.7	638.7
10	631.6	748.7	657.5	714.2	644.6	731.5
11	692.0	938.0	771.8	796.5	731.9	867.3
12	765.8 ± 15.29	968.1 ± 19.19	816.7 ± 23.20	859.7 ± 22.79	791.3 ± 19.25	913.9 ± 20.99
Dressed weight	551.4 ± 15.99	716.2 ± 15.42	578.3 ± 15.42	610.5 ± 19.01	564.9 ± 15.71	663.0 ± 17.22
Dressing percentage	72.0	73.9	70.8	70.7	71.4	72.3

TABLE 2

Mortality rates in the two lots

ITEM	LOT I			LOT II		
	Trial		Total	Trial		Total
	1	2		1	2	
Number of chicks at the start of the experiment	100	100	200	100	100	200
Number of chicks at the end of the experiment	91	89	180	95	95	190
Number of chicks that died	9	11	20	5	5	10
Average percentage of mortality	9.0	11.0	10.0	5.0	5.0	5.0

TABLE 3

Cost of feed consumed and returns above feed cost

ITEM	LOT I			LOT II		
	Trial		Average *	Trial		Average *
	1	2		1	2	
Amount of feed consumed, kilograms	332.45	337.95	335.20	371.43	362.35	366.89
Cost of feed consumed, pesos [a]	87.48	88.90	88.19	97.38	95.29	96.34
Total gain in weight of birds, kilograms	65.63	68.47	67.06	87.69	77.66	82.67
Amount of feed consumed to produce a kilogram gain, kilograms	5.06	4.93	4.99	4.24	4.67	4.46
Cost of feed required to produce a kilogram gain, pesos	1.33	1.30	1.32	1.11	1.23	1.17
Weight of broilers produced, kilograms	69.69	72.68	71.19	91.97	81.68	86.83
Returns from sales of broilers, pesos [b]	174.23	181.70	177.97	229.93	204.20	217.07
Actual returns above feed cost from broilers, pesos	86.75	92.80	89.78	132.55	108.91	120.73

[a] Cost of a kilogram of mash feed, ₱0.27; corn, ₱0.24.
[b] Cost of a kilogram of broiler, ₱2.50.
* The average of the two lots.

PULSE RATE, RESPIRATION, BODY TEMPERATURE, AND HEMOGLOBIN INDEX OF THE BLOOD OF GRADE SHROPSHIRE EWES [1]

FAUSTINO S. MENSALVAS AND ELFREN N. AQUINO

Pulse rate, respiration, body temperature, and hemoglobin index of the blood of 12 grade Shropshire ewes varied monthly and with individual animals. The mean pulse rate was 77.7 ± 0.39 beats a minute; the mean respiratory rate, 36.4 ± 0.86 times a minute; the mean body temperature, 102.1 ± 0.04°F. (38.9°C.); and the mean hemoglobin index, 9.2 ± 0.08 grams in 100 cc. of blood.

The four factors studied were slightly influenced by the season. In the dry season, the mean pulse rate was 78.0 ± 1.06 beats a minute; the mean respiratory rate, 32.2 ± 1.15 times a minute; the mean body temperature, 102.0 ± 0.08°F. (38.9°C.); and the hemoglobin index of the blood, 8.9 ± 0.14 grams in 100 cc. In the wet season, the mean pulse rate was 77.6 ± 0.69 beats a minute; the mean respiratory rate, 38.5 ± 0.99 times a minute; the mean body temperature, 102.1 ± 0.04°F. (38.9°C.); and the hemoglobin index of the blood, 9.3 ± 0.03 grams in 100 cc.

Foreign findings on the normal pulse rate, frequency of respiration, body temperature, and hemoglobin index of the blood of sheep are still being employed as a guide in determining the health of sheep in this country because of the lack of local data. Since these findings may not hold true under local conditions and to avoid errors arising from their use in such an important clinical work, a study of these four physiological characters was conducted in the Department of Animal Husbandry from January to December, 1952.

Data obtained by investigators in foreign countries on the pulse rate, frequency of respiration, and body temperature of sheep differ slightly. The approximate body temperature of this animal, according to Hadley (1939), is 103.5°F. (39.72°C.); its pulse rate, from 70 to 80 beats a minute. Udall (1922) reported the average body temperature to be 103.4°F. (39.67°C.) and the pulse rate to be the same as that found by Hadley and Dukes. Clawson, as cited by Dukes (1942), found the rectal temperature to be from 100.9 to 103.8°F. (38.28 to 39.89°C.), with an average of 102.3°F. (39.06°C.). As reported by Malkmus (1936), the range of the body temperature of sheep is from 102.2 to 104.9°F. (39.00 to 40.50°C.), with an average similar to that reported by Udall; the pulse rate is from 70 to 90 beats a minute. The respiratory rate, as found by Udall (1922), Hadley (1939), Dukes (1942), and Malkmus (1936), is from 12 to 20 times a minute.

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[1] Central Experiment Station Contribution No. 1682. Thesis presented by the junior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture. Prepared in the Department of Animal Husbandry under the direction of the senior author.

In the Philippines, Villegas (1952) found that the normal body temperature of male sheep is from 101.4 to 105.0°F. (38.56 to 40.56°C.) and that of ewes, from 101.8 to 105.2°F. (38.78 to 40.67°C.).

The range of the hemoglobin index of the blood of sheep was reported by Coffin (1945) to be from 9.0 to 14.5 grams in 100 cc. of blood. The average index found by Baker, as cited by Dukes (1942), is 11.18 grams in 100 cc. of blood.

MATERIALS AND METHODS

Twelve mature, apparently healthy female Shropshire sheep belonging to the Department of Animal Husbandry were used in this study. Animals No. 40, 47, and 52 were two years old at the start of the investigation; animals No. 24, 31, 33, and 35, three years old; animals No. 8, 11, and 21, four years old; No. 3, five years old, and No. 1, seven years old.

All the animals were subjected to identical feeding, care, and management. They were pastured with the rest of the herd during the day and kept in the sheep barn at night. Concentrate feeds, ample water, and salt were given them after pasturing. For purposes of identification, wooden tags bearing herd numbers were tied to the necks of the animals.

The pulse rate, frequency of respiration, body temperature, and hemoglobin content of the blood of all the animals were determined on the second and fourth weeks of each month between eight and twelve o'clock in the morning. The pulse rate was taken on the medial surface of the thigh where the femoral artery is located. Because of the difficulty of making a full-minute count, counting was done for ten seconds at three different times, and the average was multiplied by six. The resulting figure represented the pulse rate a minute. The rise and fall of the flanks was used as a guide in taking the respiratory count. Three counts of one minute each were made, and the average was taken to represent the frequency of respiration a minute. Body temperature was taken by inserting a veterinary clinical thermometer full length into the rectum of the animal for three minutes. The hemoglobin content of blood samples collected from the jugular veins of the animals was determined with a Haden-Hausser hemoglobinometer.

The monthly rainfall in 1952 in this region, as recorded by the Weather Observation Division of the Department of Agricultural Engineering, was as follows:

MONTH	RAINFALL	MONTH	RAINFALL
	mm.		*mm.*
January	52.0	July	—
February	40.2	August	455.5
March	22.4	September	189.7
April	9.5	October	540.1
May	133.4	November	80.9
June	242.7	December	239.9

Based on these figures, the period from January to April was taken as the dry season and that from May to December, as the wet season.

RESULTS AND DISCUSSION

Pulse rate. The animals varied in mean pulse rate (table 1). Animal No. 47 had the fastest rate, 84.3 ± 1.59 beats a minute; No. 21 had the slowest, 73.0 ± 1.45 beats a minute. The monthly mean pulse rate also fluctuated (table 2). The lowest, 73.1 ± 1.92 beats a minute, was recorded in January; the highest, 82.0 ± 1.66 beats a minute, was in October. The range in pulse rate was very wide, from 55.8 to 108.0 beats a minute; however, the mean, 77.7 ± 0.39 beats a minute for all the animals from January to December, falls within the range of the normal pulse rate reported in foreign countries.

Respiratory rate. The highest mean respiratory rate, 53.2 ± 3.41 times a minute, was obtained from animal No. 1 and the lowest, 27.6 ± 2.83 times a minute, from No. 3 (table 1). The highest monthly mean respiratory rate, 50.2 ± 3.79 times a minute, was recorded in November; the lowest, only 26.6 ± 1.52 times a minute, in April (table 2). The range in respiratory rate of the animals for the entire duration of the study was from 16 to 100 times a minute, and the mean was 36.4 ± 0.86 times a minute, which is very much higher than the figures reported by foreign authors. The marked dissimilarity may be attributed to differences in climatic conditions and in size and breed of the animals.

Body temperature. The mean body temperature varied slightly with individual animals (table 1). Animal No. 11 had the highest reading, 102.6 ± 0.10°F. (39.2°C.), and No. 24, the lowest, 101.6 ± 0.12°F. (38.6°C.). Slight fluctuations also occurred in the monthly mean body temperatures. The highest, 102.4 ± 0.16°F. (39.1°C.), was recorded in January; the lowest, 101.7 ± 0.08°F. (38.7°C.), in May. The mean, 102.1 ± 0.04°F. (38.9°C.), is a little lower than the averages found by foreign authors to be normal for sheep, but is within the normal range reported in the Philippines by Villegas (1952).

Hemoglobin index. As shown in table 1, the blood of the animals differed markedly in mean hemoglobin index. Animal No. 11 gave the highest, 10.4 ± 0.14 grams in 100 cc.; No. 3, the animal with the lowest mean respiratory rate, had the lowest, 7.6 ± 0.29 grams in 100 cc. The monthly mean hemoglobin index of the blood also varied, the highest being in June, 9.9 ± 0.27 grams in 100 cc., and the lowest in March, 8.6 ± 0.14 grams in 100 cc. The range of the hemoglobin index was from 5.0 to 12.0 grams in 100 cc. of blood. The mean was 9.2 ± 0.08 grams, which is lower than the average found by Baker, as cited by Dukes (1943). It falls, however, within the normal range reported by Coffin (1945).

Effect of season. All the factors studied were slightly affected by the season (table 3). The mean pulse rate was 78.0 ± 1.06 beats a minute in the dry season and 77.6 ± 0.69 beats a minute in the wet season.

Unlike the mean pulse rate, the mean respiratory frequency in the dry season was lower than in the wet season; it was 32.2 ± 1.04 times a minute in the summer months and 38.5 ± 0.99 times a minute on rainy days. This observation, while contrary to common knowledge and to findings of various authors, can be explained by the refreshing effect of shearing, which was done in the dry season.

The mean body temperature in the dry season was 102.0 ± 0.08°F. (38.9°C.), and in the wet season, 102.1 ± 0.04°F. (38.9°C.).

The mean hemoglobin index of the blood of the animals was slightly lower in the dry season than in the wet season. In the dry season, the index was 8.9 ± 0.14 grams in 100 cc.; in the rainy season, it was 9.3 ± 0.03 grams in 100 cc.

Other observations. During the study, all the animals, except No. 3 and No. 21, became pregnant and finally lambed. Lambing did not have any apparent effect on the pulse rate, respiration, body temperature, and hemoglobin index of the blood of the animals, but advanced pregnancy caused a slight increase in the rate of respiration.

Respiratory rate was the only factor influenced by shearing, which was done in March. The rate increased slightly after the animals had been shorn.

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TABLE 1

Mean pulse and respiratory rates, body temperature, and hemoglobin index of the blood of 12 grade Shropshire ewes

EWE NO.	PULSE RATE A MINUTE	RESPIRATORY RATE A MINUTE	BODY TEMPERATURE	HEMOGLOBIN INDEX
			°F.	*grams in 100 cc. blood*
1	76.0 ± 2.18	63.2 ± 3.41	101.8 ± 0.14	7.8 ± 0.32
3	74.7 ± 2.28	27.6 ± 2.88	101.8 ± 0.13	7.6 ± 0.29
8	79.2 ± 1.61	34.4 ± 2.40	101.8 ± 0.07	10.0 ± 0.10
11	80.3 ± 2.46	45.7 ± 3.02	102.6 ± 0.10	10.4 ± 0.14
21	73.0 ± 1.45	43.7 ± 2.77	101.9 ± 0.09	9.0 ± 0.15
24	78.6 ± 2.29	29.2 ± 1.13	101.6 ± 0.12	8.6 ± 0.15
31	75.2 ± 2.11	32.6 ± 2.01	101.6 ± 0.10	9.4 ± 0.17
33	76.6 ± 1.27	39.4 ± 3.88	101.8 ± 0.09	9.4 ± 0.12
35	74.4 ± 2.04	34.6 ± 2.38	102.2 ± 0.11	9.1 ± 0.17
40	81.0 ± 1.76	29.1 ± 1.12	102.5 ± 0.10	10.1 ± 0.10
47	84.3 ± 1.59	32.9 ± 1.76	102.6 ± 0.16	9.3 ± 0.14
52	78.1 ± 2.31	31.1 ± 1.73	102.4 ± 0.09	9.3 ± 0.23
Mean	77.7 ± 0.39	36.4 ± 0.86	102.1 ± 0.04	9.2 ± 0.8

TABLE 2

Monthly pulse and respiratory rates a minute, body temperatures, and hemoglobin indices of the blood of 12 grade Shropshire ewes

MONTH	PULSE RATE	RESPIRATORY RATE	BODY TEMPERATURE	HEMOGLOBIN INDEX
			°F.	*grams in 100 cc. blood*
January				
Minimum	55.8	21.6	100.4	8.0
Maximum	91.8	56.3	103.8	11.0
Mean	73.1 ± 1.92	36.5 ± 2.36	102.4 ± 0.16	9.3 ± 0.20
February				
Minimum	55.8	23.3	101.1	7.5
Maximum	97.8	58.6	103.6	11.0
Mean	83.1 ± 2.69	37.4 ± 2.19	102.3 ± 0.16	9.0 ± 0.21
March				
Minimum	60.0	16.0	100.8	7.5
Maximum	93.6	73.3	104.5	10.0
Mean	78.5 ± 1.90	28.1 ± 2.34	101.8 ± 0.16	8.6 ± 0.14
April				
Minimum	60.0	16.6	100.8	7.5
Maximum	96.0	42.3	102.8	10.0
Mean	79.1 ± 1.53	26.6 ± 1.52	101.7 ± 0.10	9.2 ± 0.13
May				
Minimum	60.0	25.3	101.0	7.5
Maximum	99.6	59.0	102.6	12.0
Mean	76.9 ± 1.81	39.1 ± 1.88	101.7 ± 0.08	9.7 ± 0.23
June				
Minimum	61.8	16.6	100.7	7.5
Maximum	84.0	55.6	102.7	12.0
Mean	73.7 ± 1.48	32.9 ± 1.76	102.1 ± 0.10	9.9 ± 0.27
July				
Minimum	63.6	20.0	101.0	7.5
Maximum	96.0	52.0	103.3	11.0
Mean	73.4 ± 1.77	32.5 ± 1.79	102.0 ± 0.12	9.4 ± 0.25
August				
Minimum	60.0	18.6	101.0	7.5
Maximum	97.8	61.3	103.8	11.0
Mean	76.5 ± 1.99	31.2 ± 2.08	102.2 ± 0.17	9.1 ± 0.22
September				
Minimum	57.6	24.0	101.2	8.0
Maximum	102.0	60.0	103.2	12.0
Mean	80.5 ± 2.56	34.8 ± 2.18	101.9 ± 0.15	9.6 ± 0.22
October				
Minimum	67.8	25.3	101.4	5.0
Maximum	96.0	100.6	104.1	11.0
Mean	82.0 ± 1.66	48.2 ± 2.56	102.2 ± 0.88	8.8 ± 0.27
November				
Minimum	66.0	26.6	101.0	5.0
Maximum	97.0	92.0	103.8	11.0
Mean	77.0 ± 1.85	50.2 ± 3.79	102.2 ± 0.13	9.0 ± 0.32
December				
Minimum	66.0	29.3	101.2	6.0
Maximum	93.6	77.3	103.5	11.0
Mean	81.5 ± 1.60	40.5 ± 2.75	102.3 ± 0.10	9.2 ± 0.28
Average	77.7 ± 0.39	36.4 ± 0.86	102.1 ± 0.04	9.2 ± 0.08

TABLE 3

Seasonal fluctuation of the monthly mean pulse rate, respiration, body temperature, and hemoglobin index of the blood of 12 grade Shropshire ewes

MONTH	PULSE RATE A MINUTE	RESPIRATORY RATE A MINUTE	BODY TEMPERATURE	HEMOGLOBIN INDEX
			°F.	*grams in 100 cc. blood*
Dry season:				
January	73.1 ± 1.92	36.5 ± 2.36	102.4 ± 0.16	9.3 ± 0.20
February	83.1 ± 2.69	37.4 ± 2.19	102.3 ± 0.16	9.0 ± 0.21
March	78.5 ± 1.90	28.1 ± 2.34	101.8 ± 0.16	8.6 ± 0.14
April	79.1 ± 1.53	26.6 ± 1.52	101.7 ± 0.10	9.2 ± 0.13
Mean	78.0 ± 1.06	32.2 ± 1.15	102.0 ± 0.08	8.9 ± 0.13
Wet season:				
May	76.9 ± 1.91	39.1 ± 1.88	101.7 ± 0.08	9.7 ± 0.23
June	73.7 ± 1.48	32.9 ± 1.76	102.1 ± 0.10	9.9 ± 0.27
July	73.4 ± 1.77	32.5 ± 1.79	102.0 ± 0.12	9.4 ± 0.25
August	76.5 ± 1.99	31.2 ± 2.08	102.2 ± 0.17	9.1 ± 0.22
September	80.5 ± 2.56	34.8 ± 2.18	101.9 ± 0.15	9.6 ± 0.22
October	82.0 ± 1.66	48.2 ± 2.56	102.2 ± 0.18	8.8 ± 0.27
November	77.0 ± 1.85	50.2 ± 3.79	102.2 ± 0.13	9.0 ± 0.32
December	81.5 ± 1.60	40.5 ± 2.75	102.3 ± 0.10	9.2 ± 0.28
Mean	77.6 ± 0.69	38.5 ± 0.99	102.1 ± 0.04	9.3 ± 0.03

CASE REPORT: INTESTINAL CALCULI IN A PHILIPPINE HORSE [1]

GONZALO V. GARCIA

WITH ONE TEXT FIGURE

Enteroliths or calculi are compact, smooth, stone-like bodies found sometimes in the large intestines of horses. They may be round or irregular in shape. They vary from the size of very small stones to that of bowling balls. Only the larger ones cause obstructions in the intestines. Exhibited in the New York State Veterinary College is a 10-pound enterolith which caused the death of a horse used in a lime quarry.

The occurrence of intestinal calculi among horses in the Philippines is not unknown (Austria).[2] Figure 1, upper panel, shows

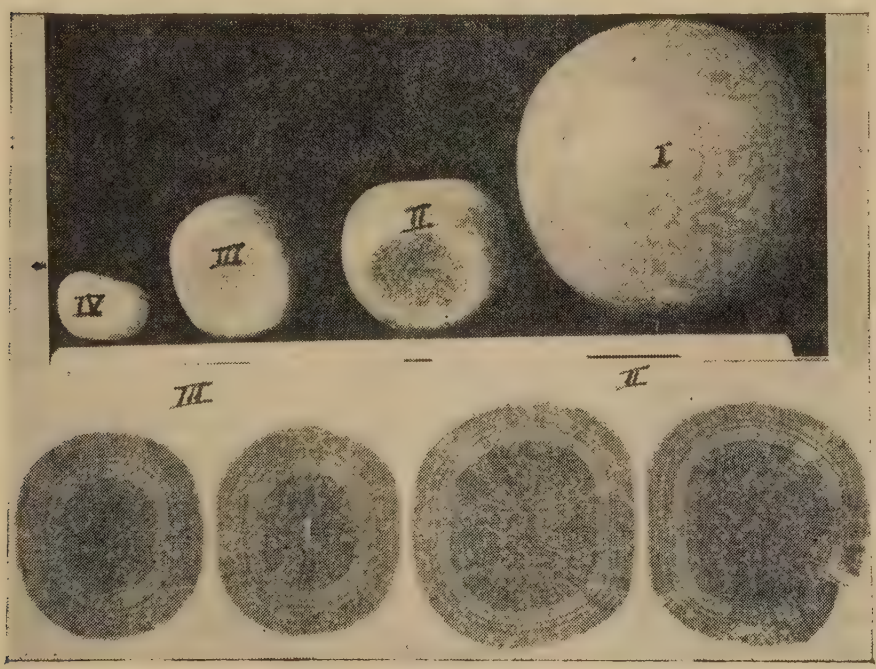

Fig. 1.—Upper panel, intestinal calculi taken from a Philippine horse; lower panel, cross sections of the calculi revealing the stratified structure.

[1] Central Experiment Station Contribution No. 1683.

[2] AUSTRIA, I. V. 1933. Intestinal calculus in a horse. Animal Industry Gazette 3 (11): 417–419.

some local specimens of intestinal calculi which were removed, after autopsy, from the colon and rectum of a 3-year-old native pony.

The horse was brought to the Department of Animal Husbandry of the College of Agriculture for treatment of an ailment with the symptoms of colic. These symptoms included general restlessness, pain and tenseness in the regions of the flanks and abdomen, and straining as if to micturate. The visible mucous membranes were congested. In addition, the animal had anorexia and constipation. The treatment of aloin and mineral oil was administered by means of a stomach tube for two days. On the afternoon of the second day, since the sick horse did not show any improvement, its rectum was palpated before it was given enema. During the examination a globular mass of stone-like consistency was noted about an elbow's length from the anus. The object was so firmly lodged in the rectum that attempts to extricate it were futile. Inasmuch as the owner did not favor further treatment, the horse was slaughtered and posted.

The size, weight, and location of each of the four stones found are tabulated below:

No.	*Size in cm.*	*Weight in grams*	*Location*
1	13.3 diameter	2,076	Dorsal colon
2	7.6 "	331	Rectum
3	6.3 "	134	Dorsal colon
4	4.4 length	20	Dorsal colon
	Total weight	2,561	

Of the four calculi, the largest weighed more than 2 kilograms and was almost the size and shape of a bowling ball. The smallest was somewhat bean-shaped, whereas the other two looked like tennis balls with two hollows on opposite sides.

True enteroliths are composed mostly of the phosphates of ammonium and magnesium, with small amounts of the carbonates and phosphates of calcium and the chlorides of sodium and potassium. They are distinct from the so-called pseudo-enteroliths in that the latter are much lighter in weight and consist of dry, mortar-like lumps. Furthermore, the surfaces of the pseudo-enteroliths are uneven and, in some instances, present sharp projections.

In the United States, the development of enteroliths is commonly attributed to the giving of wheat or rye bran, either of which contains a high percentage of magnesium phosphate. Hutyra, Marek, and Manninger [3] stated that magnesium phosphate is normally dissolved by the gastric juice before it reaches the small intestines. If a large amount is given to the animal, however, it reaches the large intestines in an undissolved form and is acted upon by the

[3] Hutyra, F. J. Marek, and R. Manninger. 1946. Special pathology and therapeutics of the diseases of domestic animals. Vol. 2. 5th ed., xi + 704 p. Chicago: Alexander Eger Inc.

alkalis present in the intestinal tract. The resulting precipitates combine with ammonia to form ammonium phosphate. This salt, together with magnesium phosphate, crystallizes around hard objects, like pieces of nails, wires, pebbles, which may have been ingested with the feeds, resulting in the formation of enteroliths. Runnels [4] added that chronic catarrhal gastroenteritis is a predisposing factor to the development of intestinal calculi.

Figure 1, lower panel, shows stones No. 2 and 3 in section to show clearly the deposition of the mineral salts. The deposition is usually in layers so that the stones appear stratified. The color of the sections varied from gray to dark brown. The nucleus was a half-inch nail in stone No. 3 and a small pebble in stone No. 2.

[4] RUNNELS, R. A. 1938. Animal pathology. 464 p. Ames, Iowa: Collegiate Press, Inc.

COLLEGE AND ALUMNI NOTES

The first group of Cornell University professors detailed to this College under the PHILCUSA-MSA technical assistance program arrived on the campus on October 2, 1952. The new additions to the College community are Prof. and Mrs. M. Robinson, Dr. and Mrs. C. A. Bratton, Prof. and Mrs. A. M. Goodman, and Dr. and Mrs. H. K. Hayes. They are staying in the newly constructed houses on Faculty Hill.

Dr. George C. Kent, head of the Department of Plant Pathology at Cornell University, arrived later in the month with his wife and three children. He is also one of the first group of Cornell professors.

Dr. F. M. Fronda, professor of poultry husbandry and secretary of the College, returned from Thailand on October 2, 1952. He stayed in Thailand for one year as a poultry expert in the employ of the FAO. Before returning to the Philippines, he visited the FAO headquarters in Rome.

The 34th Loyalty Day was celebrated on October 10, 1952, with Hon. Jose Yulo as guest of honor. The celebration started with the inspection of the escort of honor by the guest of honor. This was followed immediately by a parade, where the ROTC, students, alumni, and various campus organizations were represented, and a literary-musical program at the Baker Memorial Hall. Luncheon was then served to the guests and visiting alumni. Other activities of the day were basketball games between the UST Junior and Senior teams and the Los Baños Varsity and Junior teams and the students' loyalty dance under the auspices of the SBO.

This year's celebration, which was managed by a central committee of which Dr. Jose M. Capinpin was the chairman, was well attended by alumni, former faculty members, representatives of the MSA and PHILCUSA, and other friends of the College.

A large number of alumni attended this year's Loyalty Day. The out-of-town alumni who journeyed to the campus in order to take part in the festivities, according to the alumni register, were the following: Class of 1911—José F. Zamora; 1913—Sotero F. Albano; 1915—Nicanor G. Teodoro; 1918—Ramon V. Manio, Anastacio L. Teodoro, Jose M. Trinidad; 1920—Rufino A. Isidro, Ambrosio M. Lontok; 1922—Basilio L. Hernandez, Quirino P. Ricafrente; 1923—Ramon A. Cruz; 1924—Ulpiano V. Madamba; 1925—Cornelio V. Crucillo, Eugenio E. Cruz, Canuto G. Manuel, Pacifico L. Masibay, Fidel M. Reyes; 1926—Pedro P. Porquez; 1927—Quintin A. Eala; 1928—Sisenando R. Reantaso, Felix F. Villa; 1929—Cesario C. Bandong, Enrique D. Hemedes, Federico G. Isaac, Andres M. Mane, Arcadio G. Matela; 1930—Artemio E. Gesmundo; 1931—Gaudencio

B. Cruz, Herminio R. Espino, Felix S. Gamo, Amado A. Santos; 1932—Pedro P. Erce, Juan G. Tucay; 1933—Octavio Alzona, Ponciano F. Ortiz; 1934—Felipe T. Aala, Cesar T. Mamon, Osmundo R. Mondoñedo, Nicomedes C. Reyes, Jose K. Santiago, Generoso F. Tanseco, Alfonso L. Tecson; 1935—Venancio A. Duarte, Alberto C. Felix, Cenon R. Florcruz; 1936—Isidro T. Cayañga, Aquilino V. Platon, Hector A. Rivera; 1937—Domingo A. Altamirano, Amando M. Dalisay, Conrado C. Dinulos, Victoriano G. Rivera; 1938—Felipe T. Agdeppa, Prudencio O. Pacumbaba; 1939—Ascario G. Tuason; 1940—Alfonso B. Castro, Potenciano C. Reaño, Ramon Samaniego; 1941—Hipolito A. Custodia, Luciano E. Lactao, Ireneo M. Olalia, Ambrosio H. Ramos, Isidro R. Romero, Paterno R. Santos; 1942—Felipe P. Barile; 1943—Serapio J. Bayubay; 1944—Nelia Teodoro-Gonzalez, Romeo P. Martinez, Zacarias V. Valdez; 1945—Pedro C. Arbiso, Jose M. de la Cruz, Guillermo T. Palis, Jorge Villegas; 1946—Rufo H. Ocfemia; 1947—Manuel A. Velarde; 1948—Marcial A. Alviar, Renato I. Capinpin, Maximino C. Reaño, Guillermo P. Santos, Quirino T. Tagorda; 1949—Pedro R. Garcia, Silvestre V. Javier, Jr.; 1950—Diomedes G. Flores, Antonio U. Serraon; 1951—Gloria C. Bandong, Nestor C. Vera Cruz, Fidel G. Dijamco, Manuel C. Esguerra, Oscar M. Mabanag, Juanito G. Odejar, Vivencio D. Rodriguez, Orlando G. Santos, Levy A. Trinidad; 1952—Francisco C. Bandong, Emigdio L. Fabella, Deogracias V. Maligalig, and Juan O. Villena.

Greetings by telegram and letter were received from the following alumni who could not attend the celebration: B. M. Gonzalez, '13; Serafin F. Villodres, '30, Felix N. Salcedo, '36, Emilio T. Gamatero, '42, Elpidio F. Galado, '43, Francisco C. Bascug, '50, and Melecio E. Lopez, '51, of Baybay National Agricultural School; C. Villanueva, Federico P. Goseco, '26, Epitacio A. Lanuza, '30, Dominador D. Pascual, '30, Vicente B. Arancillo, '35, Pedro M. Asico, '35, and Bernardo S. Castillo, '40, of the Bureau of Plant Industry in Davao; Pedro D. Collado, '34, Ramon Guillem, '38, and Rasuman P. Macalandong, '36, of the Bureau of Agricultural Extension in Mindanao; Celestino P. Habito, '44, of Central Luzon Agricultural College; Andres D. Goseco, Jr., '51, and Manuel C. Iñigo, '51, of Davao; Teodoro Jauregui, '51, of Cebu; Pablo C. Macariola, '35, and Rufino C. Ayaso, '51, of Tacloban; and the Isabela agricultural teachers through Mr. Andres P. Navarro, '42.

Students taking zoology collected specimens at Dalahican Beach in Lucena, Quezon, on October 4, 1952. They were accompanied by Dr. Silverio M. Cendaña, Mr. Pablo Alfonso, Jr., and Miss Virginia Samson.

The Philippine Country Life Association went on an educational trip to Tagaytay City on October 4, 1952. Dr. Francisco M. Sacay, adviser, and Mr. Romualdo Lapis, president, headed the group.

The faculty and student body of the Rizal Institute in Canlubang, Laguna, visited the College last October 10 to witness the Loyalty

Day celebration. They were accompanied by Mr. Tranquilino Alambra, '50, Mr. Felipe Barile, '42, Mrs. Guadalupe Rola-Mapili, '50, Miss Fabiana Alviar, '49, and Miss Rosalinda Novero, '51.

A geological survey party from the Bureau of Mines to study geological formation at the source of the proposed College water system has been working on the campus since September 25, 1952. Members of the party are Mr. Felipe U. Francisco, head, and Messrs. Ruperto B. Gagolino, Lolito Miguel, and Angeles Herradura.

The following were elected members of the Board of Trustees of the Maquiling School at the meeting held on October 24, 1952: Dean L. B. Uichanco, president; Dr. F. M. Sacay, vice president-director; Prof. M. A. Gapud, secretary-treasurer; Dr. F. M. Fronda and Dr. A. G. Tan, members.

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(Required by Act No. 2580)

The undersigned, business manager of THE PHILIPPINE AGRICULTURIST, published monthly, except April and May, in English at the College of Agriculture, College, Laguna, after having been duly sworn in accordance with law, hereby submits the following statement of ownership, management, circulation, etc., which is required by Act 2580, as amended by Commonwealth Act 201:

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(Sgd.) J. M. CAPINPIN
Business Manager

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